U. S. DEPARTMENT OF COMMERCE

Technical News Bulletin

of the

National Bureau of Standards

★ *Issued Monthly* ★

Washington . February 1944[1] Number 322

CONTENTS

	Page
Signaling mirrors	9
Determining indices of refraction and dispersion of optical glass by immersion	9
Indentation hardness tester	9
Wear of tire treads	10
Commercial Standard for tire repairs by vulcanization	10
Textile research at the Bureau	11
Bonding of metals with plastics	11
Federal specifications for refractory bonding mortars	12
Weathering losses of galvanized steel	12
Distilled water system for testing laboratory	12
Reactions in the carbohydrate field	13
Anomalies in the crystalline structure of mica	13
Power factor of radio components	13
Railway track scale testing service	13
Retirement of A. T. Pienkowsky	14
Death of Ray T. Stull	14
New and revised publications issued during January 1944	14
Mimeographed material: Letter Circulars	14
Recent articles by members of the Bureau's staff published in outside journals	14

SIGNALING MIRRORS

When adrift on a liferaft, if the weather is clear, one's best chance of attracting the attention of rescue craft which come into view is by reflecting a beam of sunlight from a mirror. United States craft which travel overseas now carry signaling mirrors in their life boats and liferafts. To produce a strong signal visible over a range of several miles, the mirror must be nearly flat, not warped; and to make the reflected beam easy to aim, the mirror must include a simple, accurate aiming device; this usually takes the form of a sighting hole in the middle of the mirror.

Experiments have been conducted at the Bureau both with metal and with glass mirrors in an effort to find out how flat they should be to produce a strong signal, and also which of six different methods of aiming the reflected beam is the most effective. An instrument for measuring the flatness of mirrors has been constructed, and flatness tolerances, established by the range tests for inclusion in purchase specifications, have been expressed in terms of this newly developed planarity meter. Furthermore, an improved form of metal mirror has been developed which can be aimed perhaps even more accurately than the best glass mirrors.

DETERMINING INDICES OF REFRACTION AND DISPERSION OF OPTICAL GLASS BY IMMERSION

Conditions of wartime manufacture of optical glass have made desirable the development of an accurate and rapid method for determining the indices of refraction and dispersion of the glass. An immersion method having these characteristics is described by Conrad A. Faick and Bernard Fonoroff in the February Journal of Research (RP 1575). The apparatus makes use of the double-diaphragm system for obtaining oblique illumination. The average error in the determination of the indices of refraction of glass, based upon 144 determinations, is 2, and the maximum error is 5 units in the fifth decimal place of refractive index. The average error in the calculated ν values is 0.1; the maximum error, 0.8 Complete measurements of the index of refraction and the calculations of the ν values may be made in approximately 1½ hours.

INDENTATION HARDNESS TESTER

A diamond indenting tool which makes possible indentation-hardness

[1] Published with approval of the Director of the Budget.

tests on very hard materials, such as precious gems, abrasives, glasses, and synthetic jewel bearing materials, as well as metals, was developed several years ago by F. Knoop, C. G. Peters, and W. B. Emerson of the Bureau's interferometry section (Technical News Bulletin No. 267, July 1939). The indenter, which requires loads of less than 5 kilograms, is useful for a wide variety of work and provides a powerful new tool for investigating hardness gradients in metals in addition to extending the indentation test to brittle materials the hardness of which could not heretofore be measured quantitatively.

A tester utilizing the indenter has been developed by the Wilson Mechanical Instrument Co. of New York. This tester has found many applications in industry. Organizations using the equipment include Army and Navy laboratories; the larger manufacturers of aircraft engines and parts, aeronautical instruments, and cameras; and leading scientific research organizations.

The trend in many laboratories has been to employ indenting loads in the neighborhood of 25 or 50 grams. These are much lower than were originally contemplated in the design of the instrument. An error due to an inertial load momentarily exerted during the application of these low indenting loads was discovered at the Bureau. The error, evident only at very low loads, was inherent in the original design of the tester.

As an alternative to the task of designing a new machine for use with low loads, a simple solenoid device was suggested by members of the engineering mechanics section of the Bureau. This device, which can be easily installed on the original testing machines, satisfactorily eliminates the inertial load errors and extends the useful range of the machine to the desired low loads. The device is now being supplied by the makers of the tester.

WEAR OF TIRE TREADS

During the height of the emergency period, when all possible materials were being considered for the treads of pneumatic tires, determinations were made at the Bureau of the rates of wear of several tread materials by weighing the tire at intervals and noting the loss in weight. This method involved a minimum amount of work and required relatively few miles of driving to obtain a reasonably reliable rate of wear which could be extrapolated to predict the life of the tread. The results obtained showed the method to be feasible for passenger car tires and, in addition to yielding data on the value of different materials for treads, it indicated the effect of other details, such as the location of the tires on the car and the alinement of the wheels. In the February Journal of Research (RP1574), Frank L. Roth and W. L. Holt give data on five different tread materials, including prewar natural rubber treads. The rate of wear of the least resistant tread material was eight times that of the most resistant material. GR–S type synthetic—the principal rubber being manufactured—appears from these tests to be nearly as good as natural rubber.

COMMERCIAL STANDARD FOR TIRE REPAIRS BY VULCANIZATION

Requirements which the industry considers representative of a high standard for repairs by vulcanization of passenger, truck, and bus tires are set forth in Commercial Standard CS110–43, now available in printed form.

The standard covers inspection of the injured tire and the conditions necessary for satisfactory repairing, quality of materials, workmanship, curing methods and equipment, and guarantee to the user.

The establishment of the standard was requested by the National Association of Independent Tire Dealers, and the specifications were first drafted by a representative group of tire repair material manufacturers' engineers in Akron, Ohio, on October 15, 1942.

The specifications and methods adopted by those attending the conference were circularized for comment among a large number of manufacturers of mold equipment, tire repair shops, large national users, and Government agencies. After adjustment in the light of the information thus obtained, the recommended commercial standard was circularized to all known interested organizations for written acceptance. The accepted standard, as now published, includes the membership of the Standing Committee for future revisions of the standard, a brief history of the project, and a list of firms, organizations, and individuals that have accepted the specifications as their standard of practice. Copies are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 5 cents.

TEXTILE RESEARCH AT THE BUREAU

Research on textiles at the Bureau is directed along lines of importance to Federal and State Governments, industry, and the general public. Normally most of the work is of interest to all three of these groups, but at present the staff of the textile section is working almost exclusively on problems presented by the military and other war agencies of the Government.

Special attention has been given to research on methods and instruments for measuring textiles and their standardization, and to the development of criteria for quality and performance of textile products. By providing new tools for the study of textiles and for the control of textile processing, the Bureau has been able, with a small staff, to promote research and development work throughout the industry, thus increasing the value of textile products for the benefit of both public and private users.

Among the instruments for evaluating textiles that have originated at the Bureau are: The compressometer; flexometer; planoflex; Dreby friction meter; Kline-Schiefer tautness meter; the NBS carpet wear testing machine; the Schiefer (so-called "Frazier") hosiery testing machine; and the NBS equipment for measuring air permeability and thermal transmission of fabrics. All of these have contributed, or are contributing, to a better understanding of textiles in many laboratories throughout the country.

The importance attached by the Bureau to *performance* as opposed to *composition* of textiles is reflected in the fact that all of the instruments just referred to, evaluate characteristics related to performance. However, the Bureau has likewise developed methods of analysis for fiber composition and chemical methods for evaluating textiles, and these form the basis for some of the widely used standards of the industry.

Study of the fundamental properties of textile fibers and of the substances composing them has been the special field of the Research Associateship maintained at the Bureau by the Textile Foundation. The excellent work of this group of scientists, often described in this Bulletin, has released Bureau personnel for work along other lines. Problems relating to the utilization of surplus materials and the development of processes and methods of fabrication fall within the scope of the work of the Bureau, although work of this nature on textiles has been limited.

The Bureau cooperates fully with national associations interested in textile research and standardization. Its experience and leadership have been utilized in peace time through the Research Associate Plan, by which national associations may support research at the Bureau on problems of general interest. Among the associations which have taken advantage of this arrangement are: The American Association of Textile Chemists and Colorists, The American Society for Testing Materials (Committee D–13 on Textiles), The Textile Foundation, The Textile Research Institute, the Underwear Institute, Cordage Institute, Cotton Textile Institute, and National Association of Dyers and Cleaners. The results of this cooperative research have been published by the Bureau.

In addition to the researches of strictly military and confidential nature now in progress, the Bureau is engaged in developing methods for evaluating the basic properties of cordage fibers and in applying these methods to proposed substitutes for fibers which, because of the war, are no longer available in sufficient quantity. Ropes made from substitute fibers are being investigated. A standard lamp for testing fastness to light, against which the lamps used in other laboratories may be calibrated, is being installed. The Bureau is attempting to coordinate the efforts to standardize tests for mildew resistance of textiles and methods for the accelerated weathering of textiles which are in progress in a number of laboratories, both governmental and private.

The foregoing description is based upon a statement presented by W. D. Appel, chief of the Bureau's textile section, at a meeting in New York on November 17, 1943 under the auspices of the Textile Research Institute. This conference was the first step toward the formation of an Inter-Society Council on Textile Research. (See Technical News Bulletin No. 321; January 1944).

BONDING OF METALS WITH PLASTICS

The printing of postage stamps, currency, war bonds and other Government securities requires the use of large numbers of metal printing plates. The plate ordinarily consists of a reproduction of the engraved master plate, usually obtained by electrolytic means, fastened to a suitable base. The union of face and base is obtained by a combination of

soldering and spot welding. Despite the high degree of success attained, the method entails some drawbacks, such as flattening and straightening after warping, etc. As part of a research program in the Division of Metallurgy sponsored by the Bureau of Engraving and Printing, tests are under way to determine the merits of plastic bonding agents to supplement or to replace the soldering-and-welding method.

Several plastics suitable for metal bonding have been developed, but their extended industrial use has been held up by the war. However, a series of service tests on plastic-bonded printing plates has been started, and very promising results are being obtained. It will be necessary to extend the test runs over a long period and to conduct some tests under adverse conditions to establish definitely the possible merits of the new process for the desired use.

FEDERAL SPECIFICATIONS FOR REFRACTORY BONDING MORTARS

Federal Specification HH–M–611a for Mortar: Air-setting, Refractory, Bonding (Wet and Dry Types) has been released for the use of all Departments and establishments of the Government and became effective not later than January 1, 1944. No specification for the dry type of air-setting refractory mortar existed previous to the appearance of this one. For the wet type, a specification has been in use for the past 4 years. Since the wet and the dry types of mortars have much in common, as indicated by the results of investigations, the specification for the wet air-setting refractory mortar was extended to include both types.

A proposed specification for the heat-setting type of refractory mortar has been prepared. This is being circulated at present for comment among industrial users and manufacturers. When this proposed specification is approved by the Director of Procurement, interested consumers in the Federal Government will have at their disposal specifications for all commonly used types of refractory bonding materials.

WEATHERING LOSSES OF GALVANIZED STEEL

For nearly 30 years the Bureau has cooperated with the American Society for Testing Materials in the corrosion testing of iron and steel. These tests have been almost exclusively in the nature of long-time exposures of carefully selected commercial products. An important current project of this kind is concerned with wire and wire products—fencing, barbed wire, highway safety cables, etc. Data recently reported have a bearing on the rate at which zinc is removed from a galvanized steel surface (steel wire) as a result of continuous exposure to weathering influences. As part of its cooperation in this series of tests, the Bureau prepared a set of 400 wire specimens of carefully determined weight and length. These were built into the exposure-test frames and exposed at various test sites under distinctly different atmospheric conditions—industrial, rural, and marine. At intervals during the progress of the tests, selected specimens are removed from the frames and returned for cleaning, remeasurement of length, and reweighing. A comparison of the current weight per unit length with the initial weight per unit length gives definite information on the loss sustained by the protective zinc coating.

Data just secured on wire exposed at a rural test site in central Pennsylvania indicate that this "above-average" grade of galvanized fence wire lost approximately one-third of its protective zinc coating in about 6 years. Stated in other words, under normal service conditions, at that location, a fence fabricated from such wire should not show evidence of severe corrosion damage until after 18 or 20 years had elapsed.

DISTILLED WATER SYSTEM FOR TESTING LABORATORY

An interesting feature of the equipment in the Bureau's new Materials Testing Laboratory is a completely automatic system for preparing distilled water. The controls are designed to start the still when the level of distilled water in the reservoir reaches a predetermined minimum and to shut it off when the reservoir is filled. The water in the boiler is automatically discharged from time to time to prevent excessive accumulation of impurities. If these controls operate well, they will minimize the attention required for the production of distilled water for the several laboratories in the building.

The distributing line from the reservoir to the different floors of the building is made of an alloy not previously used, so far as is known at the Bureau, in distilled water systems. This is tin alloyed with about 3½ percent of silver. Tests made several years ago showed this alloy to be much superior in mechanical properties, especially strength and freedom

from creeping, to the pure tin commonly used for distilled-water pipes. No evidence was obtained that distilled water is contaminated by contact with the alloy. The experimental use of the silver alloy in this relatively short line should furnish definite information concerning its suitability for future installations.

REACTIONS IN THE CARBOHYDRATE FIELD

An examination of the literature of the carbohydrates reveals many reactions involving the migration of double bonds and the formation of compounds which appear only remotely related to the parent carbohydrates. Heretofore, no attempt has been made to correlate these reactions; they have been considered for the most part as a group of unrelated facts.

In RP1573 in the February Journal of Research, Horace S. Isbell endeavors to show how the peculiar properties of systems involving double bonds may be explained by the migration of electron pairs with the addition and cleavage of ions. By applying a few general principles, explanations are obtained for the formation of the four classes of saccharinic acids from the 1,2-, and 2,3-, and 3,4-enediols, for the formation of diacetylkojic acid from acetylglucosone, for the conversion of triacetylglucal to diacetylphseduoglucal, for the conversion of tetramethyl-1,2-glucoseen to ω-methoxymethylfurfural, and for the formation of furfural and levulinic acid.

ANOMALIES IN THE CRYSTALLINE STRUCTURE OF MICA

Present conditions, particularly the scarcity or nonavailability of various raw materials, have forced critical examinations of many of these materials, accompanied by tests to clear up any obscure points. Although interesting information has thus been obtained, the practical utility of much of it is often not evident at the moment. The statement applies with particular force to recent structural examinations of mica. As a supplement to studies of the thermal expansion of this substance (which has shown some irregularities in this property), X-ray structural studies of mica from two widely different sources were carried out.

In these studies, Brazil mica showed the phenomenon of double diffraction spots in both the "as-received" and the "heat-treated" condition. The result was interpreted as indicating a "mosaic" structural condition. Such a condition may be loosely thought of as a structural block pattern independent of, and contained within, the normal crystalline pattern. This structural behavior was not found in Madagascar mica, either in its ordinary state or after "heat treatment." Instead, the condition of "asterism" (indicative of "disturbed" or irregular atomic lattice conditions) was more intense after heat treatment.

X-ray or Laue examinations conducted at various elevated temperatures up to 300° C, confirmed the observations by showing that the mosaic condition was intensified in the Brazil mica on heating, together with its disappearance on cooling. These observations are consistent with those of thermal expansion carried out on the same materials. The significance of the difference in the structural condition and behavior of the two types of mica is as yet an open question, so far as the practical utilization of mica is concerned.

POWER FACTOR OF RADIO COMPONENTS

In an article in a forthcoming number of "Electronics", E. L. Hall, radio engineer at the Bureau, presents the results of measurements of power factor and apparent capacitance at room temperature for a number of radio components in the frequency range 27.5 to 200 megacycles per second. The components include condensers of several makes, sockets, tubes, and concentric cables. The measurements were made by means of a high-frequency Q-meter.

The data show the great increase in apparent capacitance when leads are unnecessarily long, as well as the wide variation in power factor among the different components. Mr. Hall emphasizes the importance of selecting components with low losses for high-frequency applications.

RAILWAY TRACK SCALE TESTING SERVICE

The Association of American Railroads and the Bureau have reached a decision concerning the railway track scale testing program. One of the Bureau's testing equipments will be placed upon a full-time schedule so as to test annually all railway master scales and such other important track scales as may be mutually agreed upon. The Bureau's test weight cars Nos. 3 and 4, of 40,000 and 80,000 pounds, which were formerly used in testing railway- and industry-owned track scales, but which

have been out of service for over a year, except when one of them was leased for a short period, (Technical News Bulletin No. 313, May 1943) have been sold to the Canadian National Railways.

RETIREMENT OF A. T. PIENKOWSKY

On December 31, 1943, A. T. Pienkowsky, physicist and chief of the Bureau's mass section, was retired after 40 years of Government service. Mr. Pienkowsky was employed by the Treasury Department in 1903 as a special inspector of custom house weights and measures. Two years later at the request of Dr. S. W. Stratton he transferred to the Weights and Measures Division of the Bureau. In connection with the many tests which his section was called upon to make, Mr. Pienkowsky studied the peculiarities of weights and balances and located certain obscure sources of error; the results of his discoveries have been recorded in previous numbers of this Bulletin. His work at the Bureau was characterized by great accuracy and care.

Lloyd B. Macurdy has been designated acting chief of the section.

DEATH OF RAY T. STULL

The Bureau regrets to announce the death on January 5 of Ray T. Stull, chief of the heavy clay products section and assistant chief of the Clay and Silicate Products Division. Mr. Stull was well known in the clay-working industry. For a period he headed the ceramics work at the University of Illinois, was connected with one of the leading brick manufacturers, and served as chief ceramist at the Bureau of Mines. He came to the National Bureau of Standards in 1927 as senior ceramic engineer. He conducted notable researches on glazes and enameled brick. With Paul V. Johnson, he did valuable work on the relation between moisture content and flow of plastic clay, and on the pore system of bricks in relation to water absorption and damage through frost action. Born at Elkland, Pa. in 1875, Mr. Stull was active up to the very day of his death. He suffered a stroke in his laboratory and died at his home a short time later.

D. E. Parsons, in charge of the section on masonry constructions, has been designated as assistant chief of the division.

NEW AND REVISED PUBLICATIONS ISSUED DURING JANUARY 1944

Journal of Research [2]

Journal of Research of the National Bureau of Standards, volume 32, number 1, January 1944 (RP1570 to RP1572, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Title page, corrections, and contents for Journal of Research, volume 31, July to December 1943 (RP1545 to RP1569, inclusive). Free on application to the Bureau.

Commercial Standards [2]

CS110–43. Tire repairs-vulcanized. (Passenger, Truck, and Bus Tires.) Price 5 cents.

CS112–43. Homogeneous fiber wallboard. Price 5 cents.

Technical News Bulletin [2]

Technical News Bulletin No. 321. January 1944. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC742. List of commercial standards. (Supersedes LC732).

RECENT ARTICLES BY MEMBERS OF THE BUREAU'S STAFF PUBLISHED IN OUTSIDE JOURNALS [3]

Equipment for large-capacity scale testing in the United States. Ralph W. Smith. The Monthly Review of the Incorporated Society of Weights and Measures (40 Byrom St., Liverpool 3, England). (51, No. 10, 114 (October 1943).

[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Subscription to Technical News Bulletin, 50 cents a year; Journal of Research, $3.50 a year (to addressees in the United States and its possessions and in countries extending the franking privilege); other countries, 70 cents and $4.50, respectively.

[3] These publications are not obtainable from the Government, unless otherwise stated. Requests should be sent direct to the publishers.

Civilian aviation of future visioned (Interview with Huge L. Dryden). Frank W. Connor. Domestic Commerce (Dept. of Commerce, Washington, D. C.) **31,** No. 25, 15 (December 1943).

Density of leather and its significance. J. R. Kanagy and E. L. Wallace. Shoe and Leather Reporter (210 Lincoln St., Boston, Mass.) 16 (November 20, 1943).

Iron as a tanning agent. J. R. Kanagy and Ruth A. Kronstadt. Hide and Leather and Shoes (300 West Adams St., Chicago 6, Ill.) **106,** No. 25, 29 December 11, 1943).

The influence of initial structure and rate of heating on the austenitic grain size of 0.5 percent carbon steel and iron carbon alloy. T. G. Digges and S. J. Rosenberg. Trans. Am. Soc. for Metals (7301 Euclid Ave., Cleveland, Ohio) **31,** 777 (December 1943).

Some properties of portland pozzolana cements. G. L. Kalousek and C. H. Jumper. J. Am. Concrete Institute (7400 Second Blvd., Detroit, Mich.) 145 (November 1943).

Grade terminology—a major problem. I. J. Fairchild. Domestic Commerce (Dept. of Commerce, Washington 25, D. C.) **31,** No. 25, 5 (December 1943).

U. S. GOVERNMENT PRINTING OFFICE: 1944